

UNITED STATES PATENT APPLICATION

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FOR

METHOD AND APPARATUS FOR PROVIDING A VIRTUAL DISTRIBUTED
GATEKEEPER IN AN H.323 SYSTEM

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BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to the field of H.323 multimedia conferencing. In particular, the invention relates to improvements for scaling H.323 systems.

5 Description of the Related Art

The International Telecommunications Union (ITU) has promulgated a number of different standards for telecommunications. The telecommunications standardization sector is referred to as the ITU-T. One of the standards developed by the ITU-T is the H.323 standard for video, or multimedia, communications over packet-switched networks. The H.323 standard uses other ITU-T standards for encoding, transmitting, and decoding the audio, video, data, and control information.

There are four primary types of devices in the H.323 standard: H.323 terminals, H.323 gateways, H.323 multipoint control units (MCUs) and H.323 gatekeepers. The terminals are multimedia terminals such as personal computers coupled to a local area network (LAN). The H.323 gateways allow the interconnection of other systems with an H.323 network. For example, an H.323 gateway could interconnect plain old telephone service (POTS) with an H.323 network. The gateways can also allow separate networks of H.323 devices to be bridged. The H.323 MCU provides support for multiparty conferencing, such as mixing and switching the audio and video signals, and bridging the conferencing setup signals. The H.323 gatekeeper provides registration, admission, and status services including authentication, address query resolution, and other services for H.323 devices.

One application of the H.323 standard is to replace circuit switched services with packet switched services. Plain old telephone service (POTS) is an example of a service

provided on a circuit switched network. Each POTS call requires a dedicated circuit from end-to-end throughout the public switched telephone network (PSTN). By placing H.323 gateways and gatekeepers in telephone central office switching systems it is possible to carry a call over a packet switched network from central office to central office. Similarly,
5 the H.323 standard can be used to provide telephone service over cable systems.

One important component of installing H.323 systems to replace circuit switched central office equipment or to provide telephone service over cable systems is supporting billing and other accounting services. To provide these services, the H.323 gatekeeper can be coupled to back-end servers (BESs) that provide authentication, accounting, billing,
10 and other services.

The H.323 gatekeeper is also responsible for managing access to the network and controlling bandwidth usage. In order to accomplish these tasks, the prior art H.323 gatekeeper retains call status information throughout the call. This means that the H.323 gatekeeper includes data about calls in progress. When the call is finished, the H.323
15 gatekeeper interfaces with the BESs to update the billing and other information.

If the H.323 gatekeeper fails, all of the information about the calls handled by that H.323 gatekeeper are lost. In a central office or cable system installation, that could result in the loss of the accounting and billing data for ten thousand or more calls in progress. Also, replacing a failed H.323 gatekeeper is difficult because the call state information
20 stored on the H.323 gatekeeper would have to be transferred to the replacement H.323 gatekeeper to prevent disruptions.

Another problem of the prior art is that it may be possible to circumvent the H.323 gatekeeper and thus the billing and access control systems. Techniques such as IP spoofing might be used to circumvent the H.323 gatekeeper and place calls without
25 authorization.

If the prior art techniques are used, the H.323 gatekeeper represents a single non-redundant point of failure. Therefore, it is desirable to have a method of improving the reliability of the H.323 gatekeeper. If the prior art techniques are used, the H.323 gatekeeper billing and access control functions can be circumvented. Therefore, it is desirable to have a method of ensuring that the billing and access control functions of the H.323 gatekeeper can not be circumvented.

SUMMARY OF THE INVENTION

A method and apparatus for improving the scalability of H.323 systems is described. In some embodiments a gate controller and an edge router are used to support the H.323 call. The edge router transmits an admission request for an H.323 call on one of its ports to the gate controller. After transmitting the admission request, the edge router waits for an admission confirmation for the call from the gate controller. The admission confirmation indicates that the call can proceed and may also include, if necessary, the Internet Protocol (IP) address and the transmission control protocol (TCP) or user datagram protocol (UDP) port number of the called H.323 device. The edge router can store call state information about the call. The call state information can include whether the call is in progress, the ringing status, and/or amount of time underway, etc., as well as appropriate accounting and billing information. The call state information is updated once the admission confirmation is received.

In some embodiments, the edge router functions like an H.323 gateway, but keeps call information too. In some embodiments, the gate controller supports call transaction requests like an H.323 gatekeeper, but does not keep call state information.

In some embodiments, the edge router uses the gate controller to receive responses to registration, admission, and status (RAS) requests. Upon receiving responses from the gate controller, the edge router can update the call state information as appropriate.

In some embodiments, if the gate controller fails, the call can continue
5 uninterrupted. Further, in some embodiments, a secondary gate controller can send a message to the edge router indicating the failure of the gate controller. The edge router can update the call state information after receiving the message and use the secondary gate controller to support registration, admission, and status requests associated with the call.

In some embodiments, if the gate controller fails, a secondary gate controller is
10 activated with the same Internet protocol address as the gate controller. In this embodiment, the failure of the gate controller should pass without any changes at the edge router.

Standard H.323 terminals and gateways need no modification to communicate with other H.323 terminals and gateways coupled to the edge router/gate controller.

15 In some embodiments, the edge router additionally supports a standard network address translation (NAT) protocol. This allows multimedia terminal adapters coupling the telephones to the edge router to have nonroutable IP addresses. By using nonroutable IP addresses, the devices coupled to the edge router cannot circumvent the billing and accounting systems. Additionally, the edge router can support an H.323 proxy server. The
20 H.323 proxy server allows inward-bound calls from an H.323 device to reach terminals and telephones coupled to the edge router. In some embodiments, mobile domain name service (DNS) is used to support this functionality.

BRIEF DESCRIPTION OF THE FIGURES

Fig. 1 is a block diagram of a network including one embodiment of the invention.

Figs. 2A and 2B are process flow diagrams of the call setup process according to one embodiment of the invention.

Fig. 1 is a block diagram of a network including one embodiment of the invention.

DETAILED DESCRIPTION

A. System Overview

Figure 1 is a block diagram of a network including one embodiment of the invention. This shows an installation of the system providing voice telephone service between two cable systems. The following description lists the elements of Figure 1, their corresponding interconnections and then describes the elements.

This paragraph lists the elements of Figure 1. Figure 1 includes an H.323 system 100, a multimedia terminal adapter (MTA) 108, a telephone 110, a network 112, an H.323 system 114, a MTA 122, a telephone 124. The H.323 system 100 includes a virtual distributed gatekeeper 102 and back end servers (BESs) 105. The virtual distributed gatekeeper 102 includes a gate controller (GC) 104 and edge routers (ERs) 106-107. The H.323 system 114 includes a virtual distributed gatekeeper 116 and BESs 117. The virtual distributed gatekeeper 116 includes a GC 118 and ERs 120-121.

This paragraph describes the interconnections between the elements of Figure 1. The telephone 110 is coupled in communication with the MTA 108. The MTA 108 is coupled in communication with the virtual distributed gatekeeper 102. The virtual distributed gatekeeper 102 is coupled in communication with the BESs 105 and the network 112. The network 112 is coupled in communication with the virtual distributed gatekeeper 116. The virtual distributed gatekeeper 116 is coupled in communication with the BESs 117 and the MTA 122. The MTA 122 is coupled in communication with the telephone 124.

The following describes the use of the elements of Figure 1. The MTA 108 and the MTA 122 provide conversion of analog voice signals to the H.323 standard. In this example, the telephone 110 is coupled to the MTA 108 which allows voice conversations

using the telephone 110 to be carried over a packet-based network such as the network 112. The MTA 108 and the MTA 122 may also include one or more of the following: a data-over-cable service interface specification (DOCSIS) interface, a bridge to a 10-Base-T network, a bridge to a home network, a G.711 codec for supporting analog telephony device, a G.723.1 low bit-rate codec, or codecs and low bit-rate codecs for encoding and decoding audio for transmission over the network 112, support for encryption and decryption, and support for video capture along with the associated codecs.

In non-cable systems, the combined MTA 108 and telephone 110 may be replaced by a personal computer, a video conferencing client device, an IP telephone, or some other device supporting IP-based signaling. In telephone central office installations, the functionality of the MTA 108 may be incorporated into the ERs 106-107 by providing G.711 codecs in the ERs 106-107 to support the conversion and packetization of the analog signal in the central office.

The H.323 system 100 is designed for installation in a cable central office but it could also be used in a telephone central office to replace circuit switched calling systems. In this example the H.323 system 100 is a cable office installation to provide telephone services over a cable system and a packet-based network. Packetized H.323 data flows from the MTA 108 into the virtual distributed gatekeeper 102. The virtual distributed gatekeeper 102 supports all of the functions normally provided by an H.323 gatekeeper and an H.323 gateway. The virtual distributed gatekeeper 102 offers greater scalability and redundancy than providing a standard H.323 gatekeeper and a standard H.323 gateway.

The H.323 packets flow into an edge router such as the ERs 106-107. The edge routers include the functionality of a standard H.323 gateway, providing IP ports for H.323 calls. Additionally, the ERs 106-107 provide a memory for storing call state information. In contrast, a standard H.323 gateway stores information about what ports are

in use, but does not maintain call state information. Further, the ERs 106-107 may include a DOCSIS interface, support for a standard network address translation (NAT) protocol, and support for H.323 proxy services. In this example, the call from the telephone 110 is being routed through the ER 106.

5 The ER 106 communicates with the GC 104 on a transactional basis to receive responses to registration, admission, and status requests. Because the GC 104 is used on a transactional basis, no call state information need be stored in the GC 104. The GC 104 can access the BESs 105 for storing accounting and billing information received from the ERs 106-107.

10 If the GC 104 fails, a call handled by one of the ERs 106-107 is not disrupted. This is because call state information is stored on the edge router handling the call. However, the GC 104 can include a port status table. A port status table lists the usage status of each of the ports on ERs 106-107. The status for each port could be *in use*, *available*, or *not functioning*. Even if the GC 104 fails, the secondary gate controller can build a new port
15 status table easily. One method of building the port status table is by sending one or more queries to the ERs 106-107 requesting port status information. Alternatively, the GC 104 can build the table incrementally as requests are made. Additionally, there is no disruption of billing information associated with the call because that information is only routed through the GC 104 to the BES 105.

20 If the GC 104 fails, it can be replaced by another gate controller without disruption of the calls in progress. One way of replacing the GC 104 after a failure is to activate another gate controller and assign it the same IP address that the GC 104 had prior to its failure. Another approach is to have a secondary gate controller send a message to the ERs 106-107 indicating that the GC 104 has failed and that the secondary gate controller is
25 now providing registration, admission, and status functions for the ERs 106-107.

Another function offered by the ERs 106-107 is support for a standard network address translation (NAT) protocol, e.g. IETF RFC 1631. The NAT protocol allows multiple devices to use nonroutable, or local, IP addresses while sharing a single routable IP address provided by the device supporting the NAT protocol. Nonroutable IP addresses have been determined by the Internet Assigned Numbers Authority (IANA) in RFC 1918. One such range of nonroutable IP addresses are the IP addresses 192.168.0.0-192.168.255.255.

By using a NAT protocol, it is possible to conserve the IP address space and offer added security. If the MTA 108 is assigned a nonroutable IP address, it is not possible for the MTA 108 to bypass the ERs 106-107 to place a telephone call. Thus, the NAT protocol can be used to ensure that calls being placed over the H.323 system 100 are processed by the ERs 106-107 and that appropriate billing and accounting records are maintained on the BESs 105.

One limitation of the NAT protocol is that it does not easily allow for packets to be directed from a host with a routable IP address to a host with a nonroutable IP address. For example, if the MTA 108 has the nonroutable IP address 192.168.0.1, then the NAT protocol does not define an easy way to route appropriate incoming packets to the MTA 108. One extension to NAT is direct inward port mapping. While this offers a partial solution for some problems with the NAT protocol, it can be difficult to implement in a larger-scale implementation. Using direct inward port mapping with the NAT protocol, a port such as the port 25 which is used for the simple mail transport protocol (SMTP) can be mapped to a specific nonroutable host such as the nonroutable host 192.168.0.1, or the MTA 108. However, when there are several thousand nonroutable hosts behind the ERs 106-107, it is not possible to rely on direct inward port mapping with NAT to allow H.323 calls to be routed to the appropriate MTA.

An H.323 proxy server can be implemented on the ERs 106-107. In conjunction with the mobile domain name service (DNS), the H.323 proxy service can allow inward calls to the nonroutable hosts such as the MTA 108. The H.323 proxy service analyzes incoming H.323 packets to the ERs 106-107 and selects the appropriate multimedia terminal adapter to receive the packet based on the information in the packet and the information in the mobile DNS records.

If mobile DNS is not used, it may still be desirable to use the NAT protocol and nonroutable IP addresses for the MTAs. In this embodiment, each MTA is associated with a public, routable, IP address, and assigned a private, nonroutable, IP address. In this embodiment, the public, routable, IP address is configured to route packets to an edge router serving the MTA in the DNS system. When the edge router receives a packet with the destination address of a public, routable, IP address associated with an MTA, the edge router routes the packet to the MTA using the private, nonroutable IP address. Outgoing packets from an MTA can be altered to reflect the public IP address associated with the MTA.

The DNS information associates the public IP address with the ERs 106-107 and then using the H.323 proxy service and the NAT protocol, inward packets can easily be routed to the private IP address of the MTA.

It is possible to include a virtual gateway in the virtual distributed gatekeeper 102. The use and functionality of a virtual gateway is described in U.S. Patent Application Serial No. 09/257,326, titled "Use of Virtual Gateway in H.323 System", by Carl Ketcham, filed February 25, 1999. For example, a virtual gateway could be introduced in the H.323 system 100 to improve the scalability and port allocation among the ERs 106-107.

The H.323 system 114 is similarly configured with the functionality of the virtual distributed gatekeeper 116 the GC 118, the BESs 117, and the ERs 120-121 being the same as their counterparts in the H.323 system 100.

The virtual distributed gatekeeper 102 and the virtual distributed gatekeeper 116 can work seamlessly with existing H.323 devices such as a standard H.323 terminal coupled to the network 112. The virtual distributed gatekeeper is transparent to a standard H.323 terminal. For example if an H.323 terminal was contacting the H.323 system 114 over the network 112, no modifications are needed to the H.323 terminal to access the telephone 124 using the H.323 protocol.

The functions provided by the GC 104 and the GC 118 are collectively referred to by their acronym RAS, which stands for registration, admission, and status. These RAS services are important for billing, accounting, call management, bandwidth management and H.323 system management. Because the GC 104 and the GC 118 are transaction oriented, there is little or no state information stored on the gate controllers. Instead, upon receiving a request, the gate controller contacts its respective back-end servers to satisfy the request. For example, the GC 104 contacts the BESs 105 to satisfy requests from the ERs 106-107.

The gate controllers do provide bandwidth management. To support this functionality, the gate controller may maintain information about port usage among the edge routers and available bandwidth to the network 112. However, this information can be recreated should the gate controller fail. For example, the gate controller could poll port status information from the edge routers using a broadcast message.

Importantly, if the gate controller fails, no call state information is lost. The only thing lost in the case of a gate controller failure are the pending requests. Because the

requests can be designed to require a confirmation or response, the edge routers can resend requests should a gate controller fail and not confirm or respond to a request.

The BESs 106 and BESs 117 are adjuncts of the virtual distributed gatekeepers. The BESs 106 and the BESs 117 provide support services such as directory lookup from names to addresses, rating services, billing, accounting services, inter-carrier settlements, user authentication, and other support services for the gate controller. Messaging between the gate controllers and the back end servers supports these services.

Because the gate controllers do not need to store state information, the reliability of H.323 systems is improved. This allows the H.323 system to support a greater number of ports as well because there is no single device that has to store call state information for tens of thousands of calls.

B. Call Setup Process

Figures 2A and 2B are process flow diagrams of the call setup process according to one embodiment of the invention. This could be used to control the setup of a call between the telephone 110 and the telephone 124 of Figure 1.

Figures 2A and 2B are drawn using principles from the Unified Modeling Language. The flow of time is from earliest, top of Figure 2A, to latest, bottom of Figure 2B, as indicated by the arrow 200. Each of the participants in the call setup process is shown as a narrow line with a thicker box indicating periods during which the participant is active in the process. Messages between participants are shown as directed lines from one participant to another.

From left to right, the participants are the MTA 108, the edge router 106, the GC 104, the GC 118, the ER 120, and the MTA 122. The network 112 is indicated as a dotted line between the GC 104 and the GC 118.

The process will now be described in chronological order. First, at time 202, the MTA 108 sends an admission request to the edge router 106. An admission request is a request by a particular H.323 terminal or gateway (e.g. the MTA 108) for permission to use the network for a particular call. The admission request includes information about the device requesting access, along with information about what sort of access is requested. For example, the request could include: the amount of bandwidth requested, the called party's name and/or number, the calling party's user authentication information, and/or other information.

At time 204, the ER 106 forwards the admission request to the GC 104 with a lookup request. The admission request includes the lookup request and serves as a request for the gate controller to grant the MTA 108 access and to lookup the Internet Protocol address of the call destination (e.g. the MTA 122). The MTA 108 can have a nonroutable IP address in some embodiments. If the MTA 108 has a nonroutable IP address, the ER 106 can support the NAT protocol and an H.323 proxy service. In this example, the MTA 108 has a nonroutable IP address and the ER 106 supports the NAT protocol and an H.323 proxy service. Accordingly, the nonroutable IP address in packets sent from the MTA 108 to the ER 106 is remapped by the ER 106 into a routable IP address before being forwarded to other devices.

At time 206, the GC 104 forwards the lookup request to the GC 118. The forwarded lookup request may omit certain details from the original admission request such as the calling party's user authentication information. The GC 104 may also access the BESs 105 to verify the calling party's user authentication information, determine the called party's address, or request rate and billing information for the call. This information need not be immediately provided to the ER 106 and can be included with the lookup

confirmation provided at time 214. Alternatively, the ER 106 could request this information separately.

At time 208, the GC 118 forwards the lookup request to one of the ERs 120-121. The GC 118 will select one of the ERs 120-121 to receive the lookup request based upon
5 port usage information on the GC 118 and other information such as if a particular destination is only served by a particular edge router or group of edge routers. In this example, the GC 118 forwards the lookup request to the ER 120.

Next, at time 210, the ER 120 returns a lookup confirmation. The lookup confirmation includes the port address to be used for the call. If the NAT protocol and
10 H.323 proxy services are being used to support the call, the ER 120 will setup the NAT port mapping tables and H.323 proxy services to route packets received on the port address to the correct multimedia terminal adapter for the call, here the MTA 122.

Next, at time 212, the GC 118 forwards the lookup confirmation to the GC 104. Because call state information is not stored on the GC 118, the only thing that needs to be
15 stored on the GC 118 is the port allocation on the ER 120.

Next, at time 214, an admission confirmation is sent to the ER 106. At this point, the GC 104 need not store any data about the call. The admission confirmation may include information that the GC 104 retrieved from the BESs 105 to authorize the call, including billing and rate information. Additionally, the admission confirmation includes
20 the addressing information for the remote terminal (e.g. the MTA 122) from the lookup confirmation.

Then, at step 216, the admission confirmation is sent from the ER 106 to the MTA 108. The admission confirmation indicates that the call may proceed and includes the port address at the ER 106 to use for the call.

Next, at time 218, the MTA 108 forwards a setup request to the ER 106. At time 220, the ER 106 forwards the setup request to the ER 120. Because the ER 106 and the ER 120 are supporting the NAT protocol and H.323 proxy services in this example, all packets between the MTA 108 and the MTA 122 pass through the edge routers to reach the other MTA.

At time 222, the ER 120 forwards the setup request to MTA 122.

Next, at time 224, in order to use bandwidth for the call, the MTA 122 sends an admission request to the ER 120. The admission request sent at time 224 is similar to the admission request sent at time 202.

At time 226, the admission request is forwarded to the GC 118. The GC 118 contacts the BESs 117 to verify the user authentication information provided in the admission request. Also, billing and rate information can be retrieved.

Next, at time 228, the GC 118 sends an admission confirmation to the ER 120. The admission confirmation includes billing and rate information. The GC 118 need not store any call state information about the call once the admission confirmation is sent.

At time 230, the admission confirmation is forwarded to the MTA 122.

Next, at time 231, the MTA 122 acknowledges the setup request. The setup acknowledge is relayed back to the MTA 108 at times 232-234.

With the setup request acknowledged, the call can now proceed. In the H.323 standard, the receiving end sends messages indicating that the call is proceeding, ringing, etc. In this example, the MTA 122 relays call proceeding messages to the MTA 108 via the edge routers at times 236-240. As the MTA 122 rings the telephone 124 attached to the MTA 122, alert messages are relayed from the MTA 122 to the MTA 108 at times 242-246. When the telephone 124 is picked up, the MTA 122 relays connect messages to the MTA 108 at times 248-252.

Once the callers are connected, the bandwidth is committed. The ER 106 sends a bandwidth commit message to the GC 104 at time 254. The present H.323 standard does not include such a message. In some embodiments, the bandwidth commit message is a proprietary message. In other embodiments, the H.323 standard is extended to include a bandwidth commit message. The GC 104 forwards the bandwidth commit message to the GC 118 at time 256. The GC 118 forwards the bandwidth commit message to ER 120 at time 258. The bandwidth commit message can be used by the gate controllers to update their management information about bandwidth in use without reference to a particular call.

Additionally, at time 255, the ER 106 generates an accounting message to the GC 104. This message can be sent at any time after the bandwidth commit message. The accounting message indicates that a call started at a particular time. In some embodiments, the message includes the amount of bandwidth and types of services being used. The GC 104 will store that information in the BESs 105. Once the accounting message has been stored on the BESs 105, the GC 104 need not maintain any call state information. However, the GC 104 may optionally maintain call state information. At time 260, the ER 120 sends an accounting message to the GC 118. This allows both the calling and called party to be billed for calls as is appropriate based on the rate plan and bandwidth used by the call.

Finally, at time 262, the final call negotiations (e.g. capability exchange, master-slave determination, communication mode setup, etc.) take place to establish the call. This includes H.323 call negotiations using the H.245 protocol. After the H.245 negotiations are complete, logical channels are opened between the two MTAs that allow the telephones coupled to the MTAs to communicate.

If during the call, additional bandwidth is needed, the edge routers will repeat the process shown at times 254-260. Similarly, when the call is finished, call teardown, bandwidth release and/or accounting messages will be generated in a fashion similar to those shown in steps 254-260.

5 In this fashion, the GC 104 and the GC 118 are used for transaction processing rather than to store state information. Because the gate controllers only need to respond in a transaction oriented fashion, any failure of a gate controller is noncritical and does not disrupt the call or the accounting for a call in progress. As each of the messages is relayed through the ERs 106 and 120, call state information is constantly updated as appropriate
10 on the edge router.

For each port where call state information is being maintained, the information stored on the edge router can include: the amount of bandwidth currently in use, the amount of bandwidth authorized for the call, user authentication information associated with the call, the length of the call, the start time of the call, and rate information
15 associated with the call.

In some embodiments, if the gate controller fails, a secondary gate controller can assume the responsibilities of the failed gate controller. In one embodiment, upon a failure of the gate controller, e.g. the GC 104, a secondary gate controller in the H.323 system
100 is activated with the same IP address that the GC 104 was using. For example, if the
20 GC 104 had the IP address 192.168.100.100, the secondary gate controller could assume that IP address upon the failure of the GC 104. In this configuration, the ERs 106-107 do not need to be directly notified of the failure of the GC 104. Any pending requests from the ERs 106-107 to the GC 104 will not be acknowledged and will eventually be resent using the same IP address and will be sent to the secondary gate controller.

In other embodiments, the secondary gate controller monitors the GC 104 and upon a failure, sends a message to the ERs 106-107 indicating that the GC 104 has failed and indicating that the secondary gate controller will provide the services previously provided by the GC 104. Upon receiving the message from the secondary gate controller, the ERs 106-107 can re-transmit any pending requests to the secondary gate controller. Further, future requests will be sent to the IP address of the secondary gate controller.

C. Alternative Embodiments

Some embodiments of the invention include interface cards implementing one or more edge routers and/or implementing one or more gate controllers. The interface cards could be used in a Total Control™ Multiservice Access Platform provided by 3Com Corporation, Santa Clara, CA.

In addition to using the network address translation protocol to prevent the billing systems from being bypassed, internal IP address spoofing can be prevented by using an identifier associated with each MTA. For example, if the MTA uses the DOCSIS standard, each device has a unique identifier. Similarly, if the MTA uses the Ethernet standard, every Ethernet device includes a unique medium access control (MAC) address.

In some embodiments, the virtual distributed gatekeeper can be hardware based, software based, or a combination of the two. In some embodiments, edge router programs and gate controller programs are included in one or more computer usable media such as CD-ROMs, floppy disks, or other media.

Some embodiments of the invention are included in an electromagnetic wave form. The electromagnetic wave form comprises information such as edge router programs and gate controller programs. The electromagnetic waveform might include the edge router programs and gate controller programs accessed over a network.

D. Conclusion

Therefore, a method and apparatus for a virtual distributed gatekeeper has been described. The virtual distributed gatekeeper improves the scalability and the reliability of H.323 systems. The virtual distributed gatekeeper improves the redundancy of an H.323 system by eliminating the gatekeeper as a single point of failure. The virtual distributed gatekeeper supports protocols that reduce the ability of a user to circumvent the billing and authorization systems while also conserving IP addresses.

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